Appl. No.:   09/727,032
Amdt. dated September 25, 2003
Reply to Office action of July 8, 2003

ARGUMENTS / REMARKS

Applicant respectfully acknowledges receipt of the Office Action mailed July 8, 2003. In that Office Action, the Examiner: (1) objected to the title of the application; (2) objected to claims 5 and 14; (3) rejected claims 1-20 under 35 USC § 112, 2nd paragraph; (4) rejected claims 1-3, 10, 16-17 and 20 under 35 USC § 102(b) based on US Patent No. 5,448,701 to *Metz*; (5) rejected claims 4-6, 8-9, 11-15, and 18-19 under 35 USC § 103 based on *Metz* and US Patent No. 6,338,133 to *Schroter*, and (6) rejected claim 7 based under 35 USC § 103 based on *Metz*, *Schroter*, and an article co-authored by Peterson and Silberschatz. Applicant has cancelled claims 2-4, and have amended various other claims, and now respectfully request reconsideration for the reasons that follow.

I.   OBJECTION TO TITLE

The Examiner objected to the title as not descriptive. In response, Applicant has amended the title to make it more descriptive. The amended title is "Arbitration Based on Workload."

II.   OBJECTION TO CLAIMS

The Examiner objected to claims 5 and 13 based on minor informalities. With respect to claim 5, Applicant has adopted the Examiner's proposed changes, except that the term "compares" was not changed for grammatical reasons.

With respect to claim 13, the examiner indicated that this claim failed to further limit claim 11. Applicant has amended claim 13 to change the focus of that claim, and requests examination and allowance of that claim. Support for the amendment to claim 13 may be found at page 10, lines 4-5 of the application.

III.   REJECTION UNDER 35 USC § 112, 2ND PARAGRAPH

The Examiner rejected claims 1-20 as indefinite under 35 USC § 112, 2nd paragraph. Applicant has amended certain of these claims to remove the ambiguity, and requests reconsideration for the reasons that follow. The amendments made to obviate the § 112 rejection were not intended to narrow the scope of any claim.

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Claims 1, 4, and 7 were separately rejected for purportedly having an improper antecedent basis. Specifically, the Examiner rejected claim 1 because of the term "the workload" in lines 5-6; claim 4 because of the term "the number" in line 2; and claim 7 because of the term "the length" in line 2. While Applicant disagrees that the use of the term "the" in this context creates indefiniteness or confusion in these claims, Applicant has amended claim 1 and/or the claims at issue to remove this perceived antecedent problem.

Claim 11 was rejected for improper antecedent basis for the term "signal" and "number." Claim 11 has been amended to use the word "the" before "signal" instead of "a," and conversely, the term "a" now is used before the word "number." In addition, claim 11 has been amended to clarify that the device indicates to the bus arbiter the number of pending operations, without limiting the manner in which this indication is made.

The Examiner rejected claim 12 on the basis that there was "insufficient antecedent basis" for the term "a request" in line 2. The Examiner then noted that further clarification was necessary if the request in claim 12 differed from the request signal in claim 11. Applicant has broadened claim 12 and thus removed this issue.

The Examiner also indicates that the term "a queue" in line 1 of claim 13 has "insufficient antecedent basis." Applicant has amended claim 13 to remove this issue.

Claim 14 was rejected because of concern regarding the antecedent basis of "a queue" in line 1. This issue has been resolved by amendment. Claims 16, 18 and 20 have been amended to eliminate antecedent concerns raised by the use of the term "the."

Based on the foregoing, Applicant respectfully requests reconsideration of the 35 USC § 112, 2nd paragraph rejection.

IV.   REJECTION UNDER 35 USC § 102(B)

The Examiner rejected claims 1-3, 10, 16-17, and 20 based on US Patent No. 5,448,701 to *Metz*. Applicant respectfully requests reconsideration.

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A.   The *Metz* Patent

The *Metz* patent discloses a system for coordinating data transfers on a shared data bus, such as that shared by a local area network (LAN). *See Metz* patent at 1:12-15; 3:21-24. The LAN's connect to the bus by way of an adapter, with each LAN having an associated adapter. 3:21-24. Each adapter has an input buffer and an output buffer connected to the shared bus. 3:38-40. The input buffer receives data from the LAN and the adapter transmits the contents of the input buffer onto the shared bus. 3:40-43. Data received by the adapter from the shared bus is placed in the adapter's output buffer, where it is accessed by the LAN. 3:43-45.

A central arbiter connects to each of the adapters. 3:35-37. The central arbiter controls the adapters and determines which adapter can transmit data on the bus, and which adapter receives the data on the bus[1]. 3:48-53. The central arbiter uses a special arbitration scheme to control which LAN will send data and which LAN will receive data. In particular, the central arbiter determines if an input buffer is almost full, and if there exists an output buffer available to accept the data from the almost full input buffer. 3:54-57. If such a set of input and output buffers exists, then the adapters where those buffers reside are granted bus access. 3:57-60. The stated goal is to minimize the possibility of having an input buffer overflow with data, which leads to loss of data. 3:60-63. If there is no almost full input buffer, then the central arbiter determines if an output buffer is nearly empty and if an input buffer exists with data for the nearly empty output buffer. 3:63-66. If that condition exists, then the adapters containing those buffers are granted priority for gaining bus access. 3:66-68. If there is no nearly empty output buffer, the central arbiter determines if there is a non-full output buffer, and if so, the non-full output buffer is matched with an input buffer with data targeted for that output buffer.

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[1]   The *Metz* patent makes clear that it is a necessary requirement of that system that each adapter can manipulate header data to determine the target or destination LAN of a block of data that the adapter has received in its input buffer. 4:31-34.

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Each adapter maintains one or more control lines that communicate with the central arbiter. 4:48-49. The control lines advise the central arbiter of the capacity of the input and output buffers of an adapter, and also target output buffers for the data in the input buffer of an adapter. 4:50-53. One of the control lines indicates that the input buffer has exceeded a predefined threshold and is in danger of overflowing. 4:55-57. A second control line indicates that the output buffer has exceeded a threshold and is in danger of going empty. 4:63-66. A third control line indicates that the output buffer is full and cannot receive data. 4:68 – 5:2.

B.   The Allegedly Anticipated Claims
Differ Patentably from the *Metz* Patent

Each of the independent claims of the present application differ materially from the *Metz* patent. First, claim 1 recites a computer system that includes a computer bus coupling a plurality of bus devices and a bus arbiter . The *Metz* patent is not directed to a computer system or to a computer bus or bus devices in a computer system. Instead, *Metz* is directed to a wide area network in which multiple local area networks (LAN's) are linked together. *Metz* is directed to the transfer of data in such a WAN, not the manner in which data is transferred inside a computer. With respect to the limitations of claim 1, *Metz* does not disclose, suggest or mention a computer bus or a plurality of bus devices that form part of a computer system. Consequently, *Metz* cannot anticipate the teachings of claim 1.

Nor does the *Metz* patent render obvious the teachings of claim 1. First, the Examiner must carry his *prima facie* burden of showing that it would have been obvious to use transmission techniques and arbitration schemes that were disclosed for use in communications between LAN's in the architecture of a computer system. The Examiner has not made such a showing, and instead has arbitrarily equated the *Metz* WAN system with Applicant's claimed computer system.

In addition, claim 1 as amended requires that the bus devices indicat a numb r of operations pending in the queue, and that conflicting requests be resolved based on the number of operations pending in the queue. The *Metz*

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WAN does not operate in this fashion. In *Metz*, the only indication of workload that is made is one indicating that a buffer is subject to overflowing. Secondly and more critically, multiple requests in *Metz* are resolved not based on the number of operations pending in the queue of the bus device, but instead by determining which of the targeted devices has space to accept data. In the system claimed, the requesting device that has the most operations is awarded access to the bus. That is not true in *Metz*, because a device with the fullest input buffer may not be granted access to the shared bus if the targeted device does not have access to the bus.

As the Examiner has recognized in the discussion of claim 4, *Metz* does not disclose or suggest indicating to the central arbiter the fullness of the buffer. *See* Office Action at 7. Instead, *Metz* discloses that one of the control lines indicates that the input buffer has exceeded a predefined threshold and is in danger of overflowing. 4:55-57. Another control line indicates that the output buffer has exceeded a threshold and is in danger of going empty. 4:63-66. Thus, the only signal *Metz* provides is to indicate an overflow condition in an input buffer, and a signal to indicate that an output buffer is in danger of being empty. Because *Metz* does not identify the specific number of operations pending (or even multiple ranges of pending operations), it cannot identify which device has a greater number of operations pending with any degree of specificity. *Metz* can only determine if buffer capacity is over or under a threshold value.

In the Office Action, the Examiner seeks to overcome this fundamental deficiency in *Metz* by referring to the *Schroter* patent. As the Examiner has noted, this patent relates to the manner in which a processor handles branch instructions, and does not relate in any appreciable fashion to arbitration of a computer bus. In particular, the *Schroter* patent determines whether to dispatch a speculative instruction based on current loading conditions in the instruction queue. 2:55-60. Speculative branch instructions are dispatched to the execution unit of the processor when the number of instructions queued at the execution unit is lower than a threshold value. 3:26-50. As best understood by the undersigned, this means that the amount of resources dedicated to branch

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predictions is determined by the number of instructions queued at the execution unit.

The *Schroter* patent appears to offer nothing that overcomes the deficiencies that exist with the *Metz patent*. Like *Metz*, it appears to merely signal when a threshold value has been met, and it offers nothing constructive regarding arbitration or computer bus systems. Nor do the combined teachings of *Metz* and *Schroter* meet the limitations of claim 1 as amended, because there is no suggestion or teaching to resolve conflicts between devices requesting access to a computer bus based on the number of operations pending in the queue. Absent this teaching, the rejection to claim 1 must fail.

Given these basic and fundamental differences between claim 1 and the *Metz* patent, Applicant respectfully seeks reconsideration of the rejection to claim 1 and allowance of that claim.

Claims 2 and 3 have been cancelled by this amendment. Claim 10 depends from claim 1, and thus is allowable for that reason. In addition, claim 10 requires that the number of pending operations be quantified by a combination of specific numbers and at least one range, which is a feature lacking in *Metz*. *Metz* only discloses a range for the input buffer to indicate an overflow condition, and thus cannot meet the limitations of claim 10.

Claim 16 is an independent method claim, which is patentable over *Metz* for the same reasons as claim 1. Claims 17 and 20 depend from claim 16 and are allowable for at least that reason.

V.   REJECTIONS UNDER 35 USC § 103

The Examiner rejected claims 4-6, 8-9, 11-15, and 18-19 based on the combined teachings of *Metz* and *Schroter*. Claim 7 was rejected based on these teachings and the teachings of the Peterson and Silberschatz article. Applicant respectfully requests reconsideration.

Claim 4 has been cancelled, and its salient features incorporated into claim 1. Thus, Applicant incorporates by reference comments made regarding claim 1 to all claims dependent on claim 1, and comments made regarding claim 16 to all claims dependent on claim 16.

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Claims 5-9 depend from claim 1 and thus are allowable for at least that reason. Claim 5 also adds the further requirement that the bus device with the most operations pending is granted access to the bus. This is not taught in any of the references of record, and in fact, is inconsistent with *Metz*, which always considers the available space in the targeted device. Claim 7 requires the use of a round-robin approach in the event a tie exists. This feature of using pending operations in conjunction with a round-robin approach is not suggested by the prior art. It is only through a hindsight analysis that the examiner might hypothetically attempt to re-create claim 7, and even then, the prior art fails to include the limitations of claims 4 and 5. Since *Metz* and *Schroter* each use a threshold signal, it is clear that neither implements a multi-bit signal to identify the number of queue entries, and thus claims 8 and 9 are patentable for this additional reason.

Given the foregoing, Applicant respectfully submits that claims 5-6 and 7-9 would not have been obvious, and thus should be allowed.

Claim 11 requires that any device with pending operations indicate to the bus arbiter the number of operations pending, and that the arbiter use this information to resolve conflicts. This feature is neither suggested nor disclosed, either alone or in combination, in the references of record. Claim 11 is clearly allowable over the art of record. Claims 12-15 depend from claim 11, and thus are allowable for at least that reason. Claims 14 and 15 also limit the size of the queues. The prior art of record is silent on the relative queue size.

Given the foregoing, Applicant respectfully submits that claims 11-15 would not have been obvious, and thus should be allowed.

Claims 18-19 depend from claim 16 and are allowable for at least that reason. In addition, claims 18 and 19 are allowable for the same reasons as claim 4.

VI.   CONCLUSION

Applicant respectfully requests reconsideration and allowance of the pending claims. If the Examiner feels that a telephon conference would

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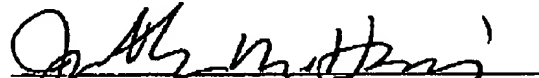Reply to Offic   action of July 8, 2003

expedite the resolution of this case, he is respectfully requested to contact the undersigned.

In the course of the foregoing discussions, Applicant may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims. Moreover, it should be understood that there may be other distinctions between the claims and the prior art which have yet to be raised, but which may be raised in the future.

If any fees or time extensions are inadvertently omitted or if any fees have been overpaid, please appropriately charge or credit those fees to Hewlett-Packard Company Deposit Account Number 08-2025 and enter any time extension(s) necessary to prevent this case from being abandoned.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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